CLEAN AIR TASK FORCE

May 8, 2019

Does nuclear energy have a role in a law carbon future?

State Considerations about the Future Role of Nuclear Energy

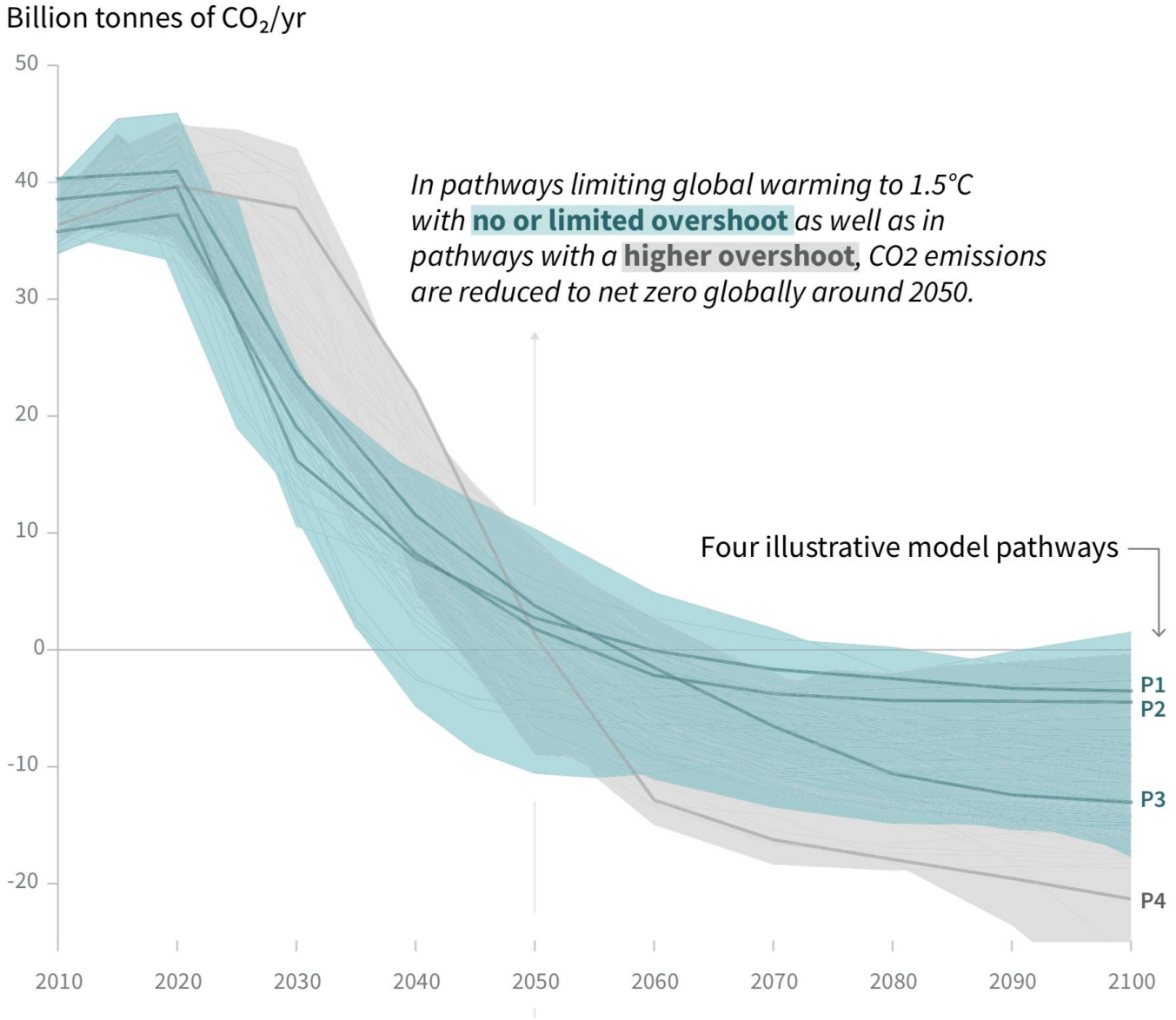
2019 National Conference of Regulatory Attorneys

Nashville, Tennessee

May 8, 2019

Armond Cohen, Executive Director, Clean Air Task Force

Global total net CO_2 emissions



100% carbon-free grid statutes

California

New Mexico

Washington State

Nevada

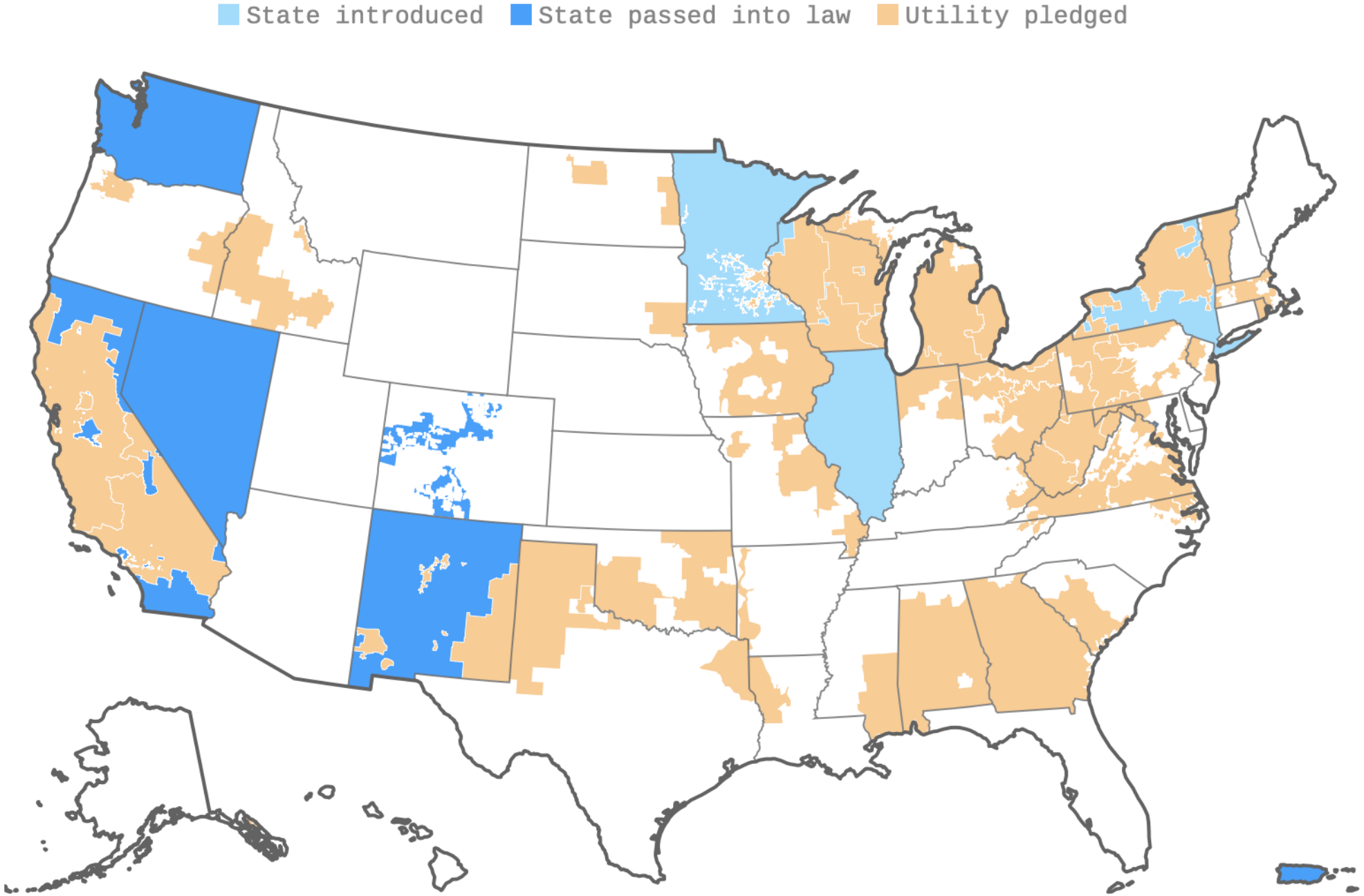
Illinois

New York

Minnesota

Wisconsin

States and utilities that have set climate change-related targets since 2017

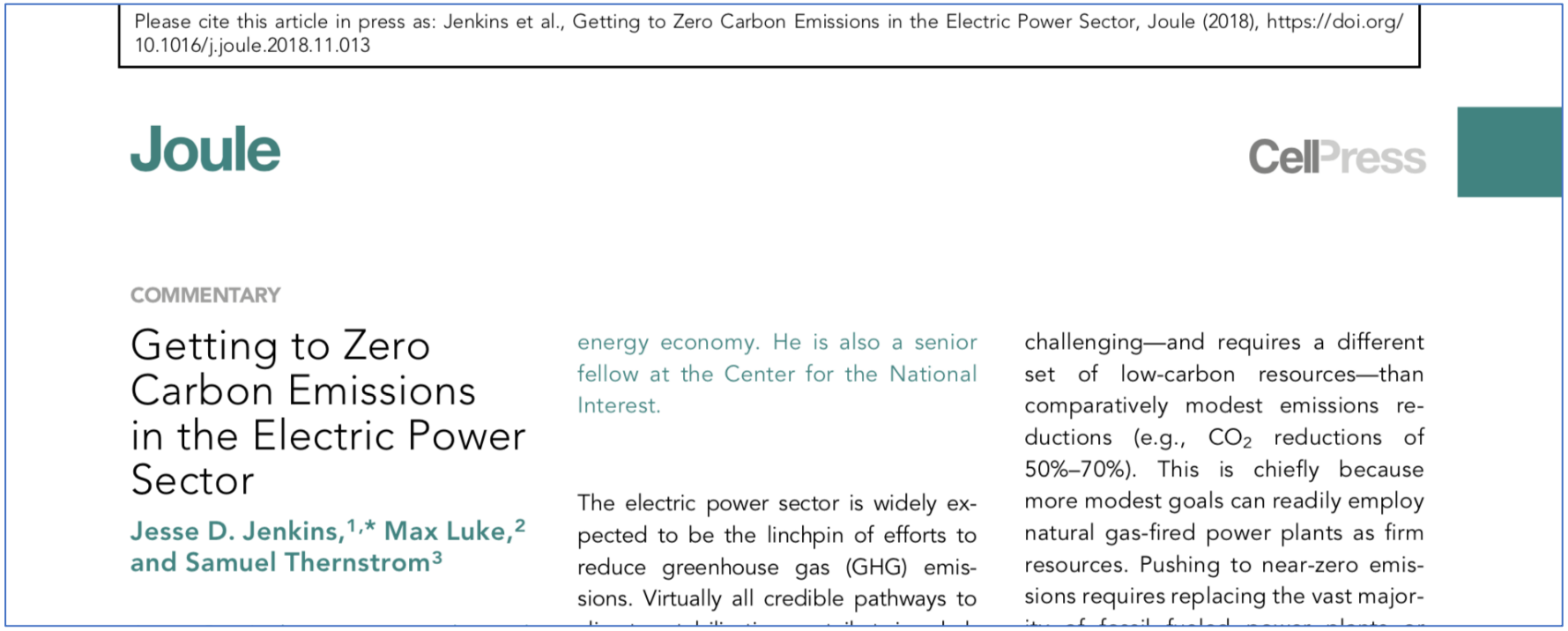


Our zero carbon options

Variable/weather-dependent

Dispatchable/firm

Review of 40 studies: having firm zero carbon power available reduces costs and risks in achieving a zero carbon grid especially as reductions move > 50%



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Joule

CellPress

COMMENTARY

Getting to Zero Carbon Emissions in the Electric Power Sector

Jesse D. Jenkins,[1,*] Max Luke,[2] and Samuel Thernstrom[3]

energy economy. He is also a senior fellow at the Center for the National Interest.

The electric power sector is widely expected to be the linchpin of efforts to reduce greenhouse gas (GHG) emissions. Virtually all credible pathways to

challenging—and requires a different set of low-carbon resources—than comparatively modest emissions reductions (e.g., CO_2 reductions of 50%–70%). This is chiefly because more modest goals can readily employ natural gas-fired power plants as firm resources. Pushing to near-zero emissions requires replacing the vast major-

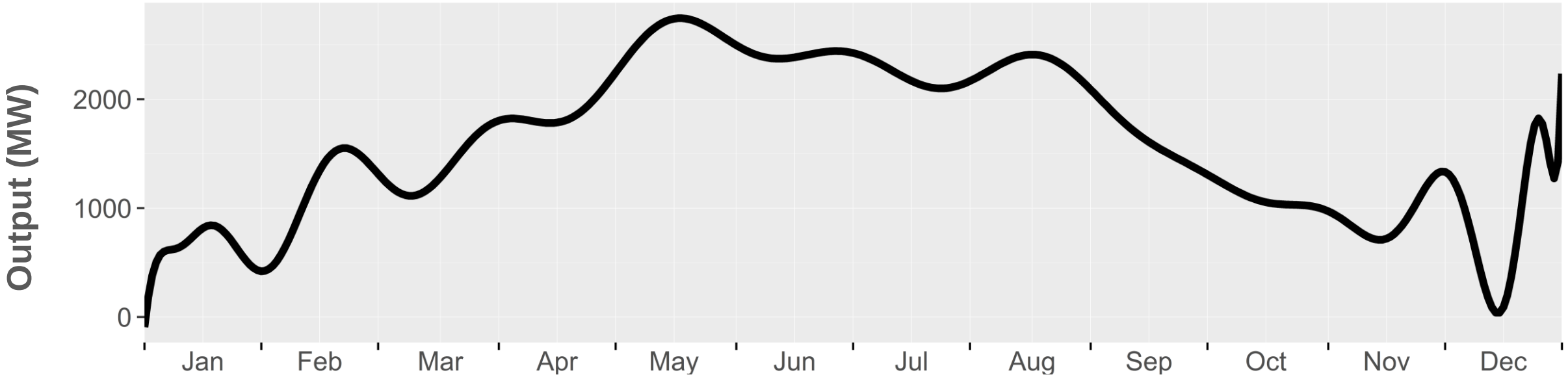
Why is this so?

Let’s look at California as a case study.

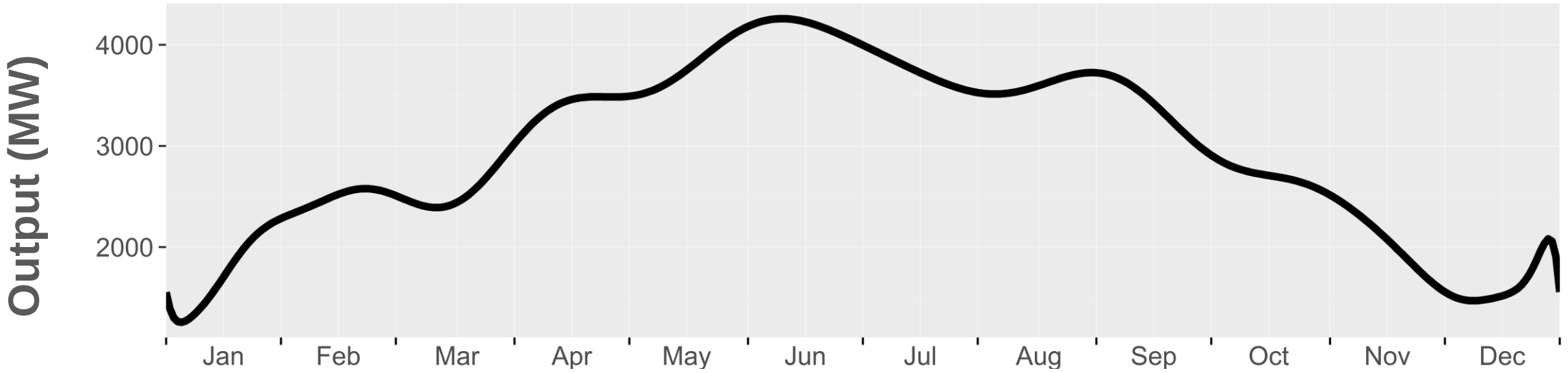
In California, as in most of the Northern Hemisphere, wind and solar varies substantially not just *daily* but *weekly-monthly*, in a way that does not always match load

At high levels of wind and solar energy (> 50-60% of system energy), "filling the gap" begins to pose serious cost challenges

Smoothed Daily Average Wind Production in CAISO, 2018

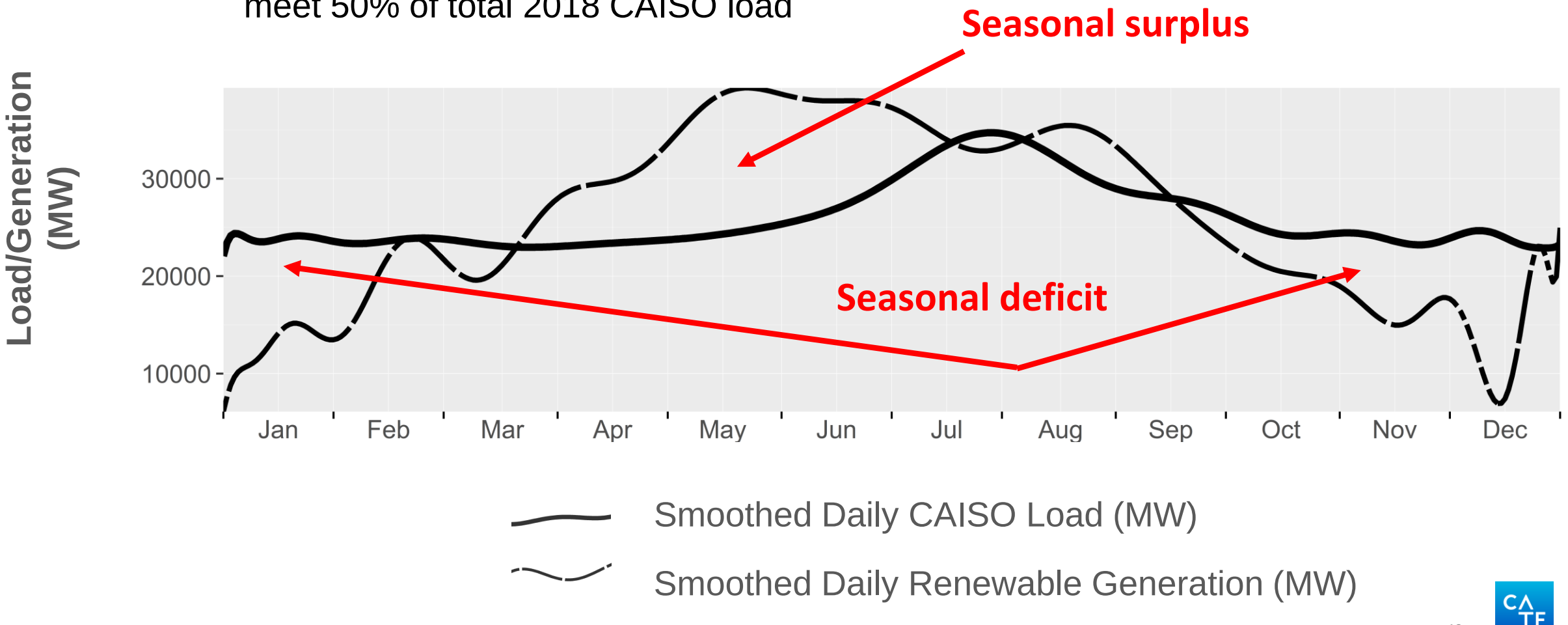


Smoothed Daily Average Solar Production in CAISO, 2018



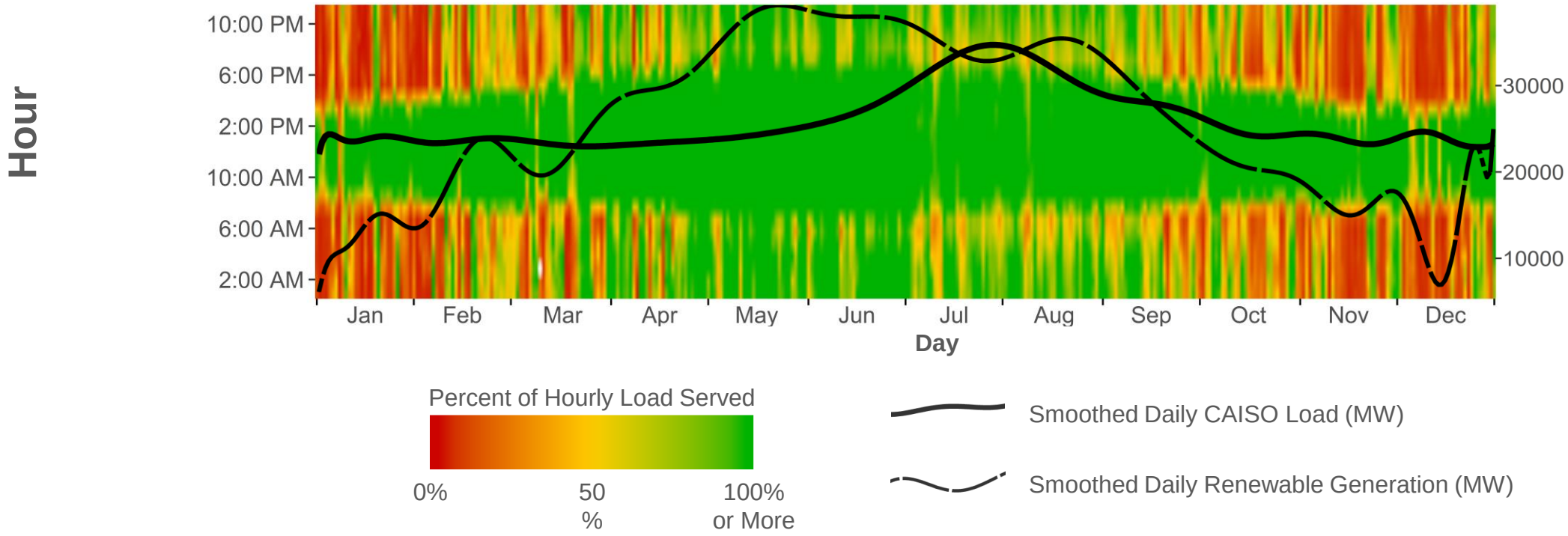
Smoothed Daily Load & Renewable Energy Generation, Mixed Renewable Scenario

Scenario definition: 2018 wind and solar generation scale to each meet 50% of total 2018 CAISO load



Percent of Hourly Load Served, Mixed Renewable Scenario

Scenario definition: 2018 wind and solar generation scale to each meet 50% of total 2018 CAISO load

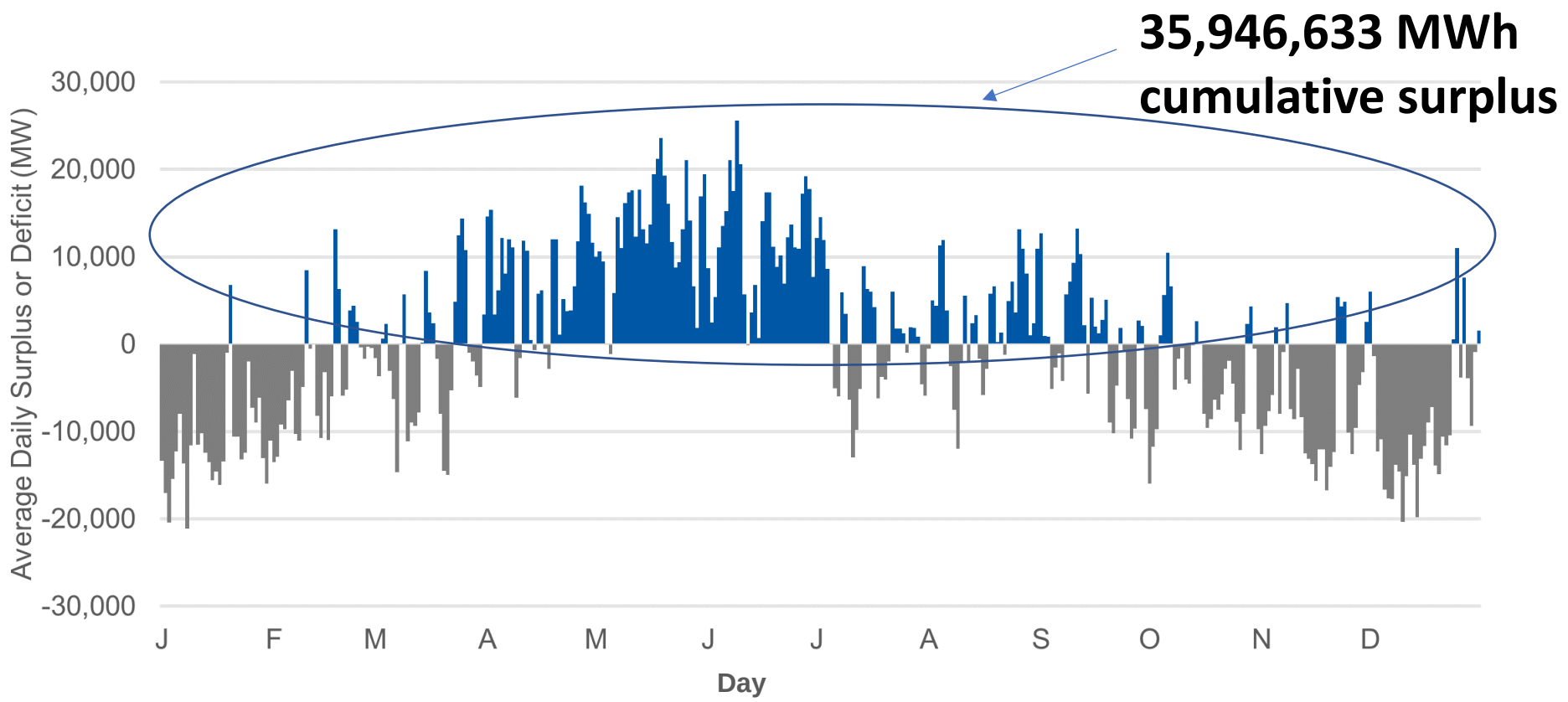


73% of annual load covered by wind and solar

Can we solve this problem with batteries or other energy storage to capture the seasonal surplus and use it in deficit periods?

Daily Renewable Energy Generation Surpluses and Deficits, Mixed Renewable Scenario

Scenario definition: 2018 wind and solar generation scale to each meet 50% of total 2018 CAISO load



The storage solution

Surplus to store and use = 35,946,633 MWh or 18% of annual CAISO load

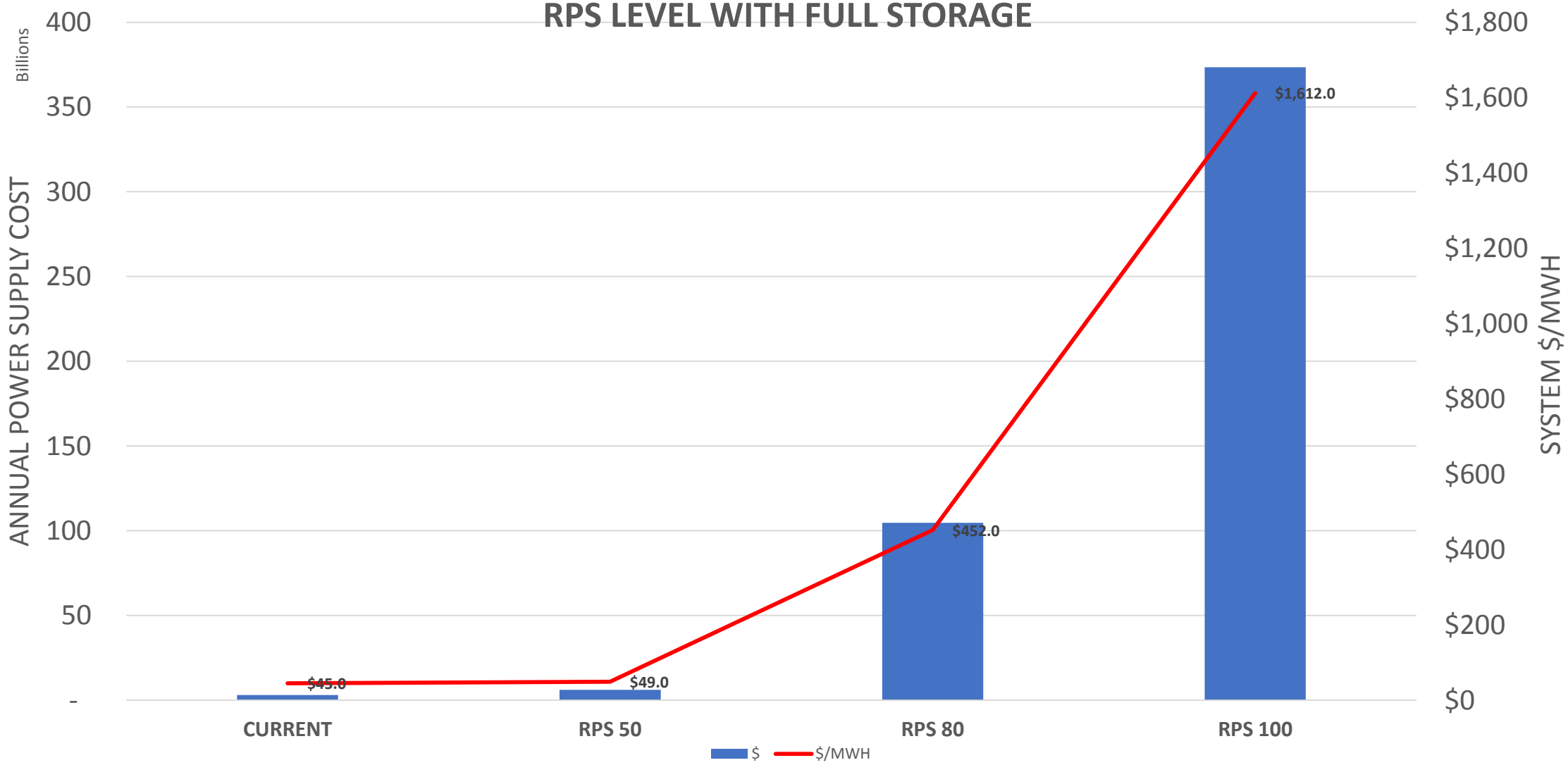
Assume $100/kwh for storage capacity (~ 60-80% drop from today's costs)

Capital cost = $3.59 Trillion

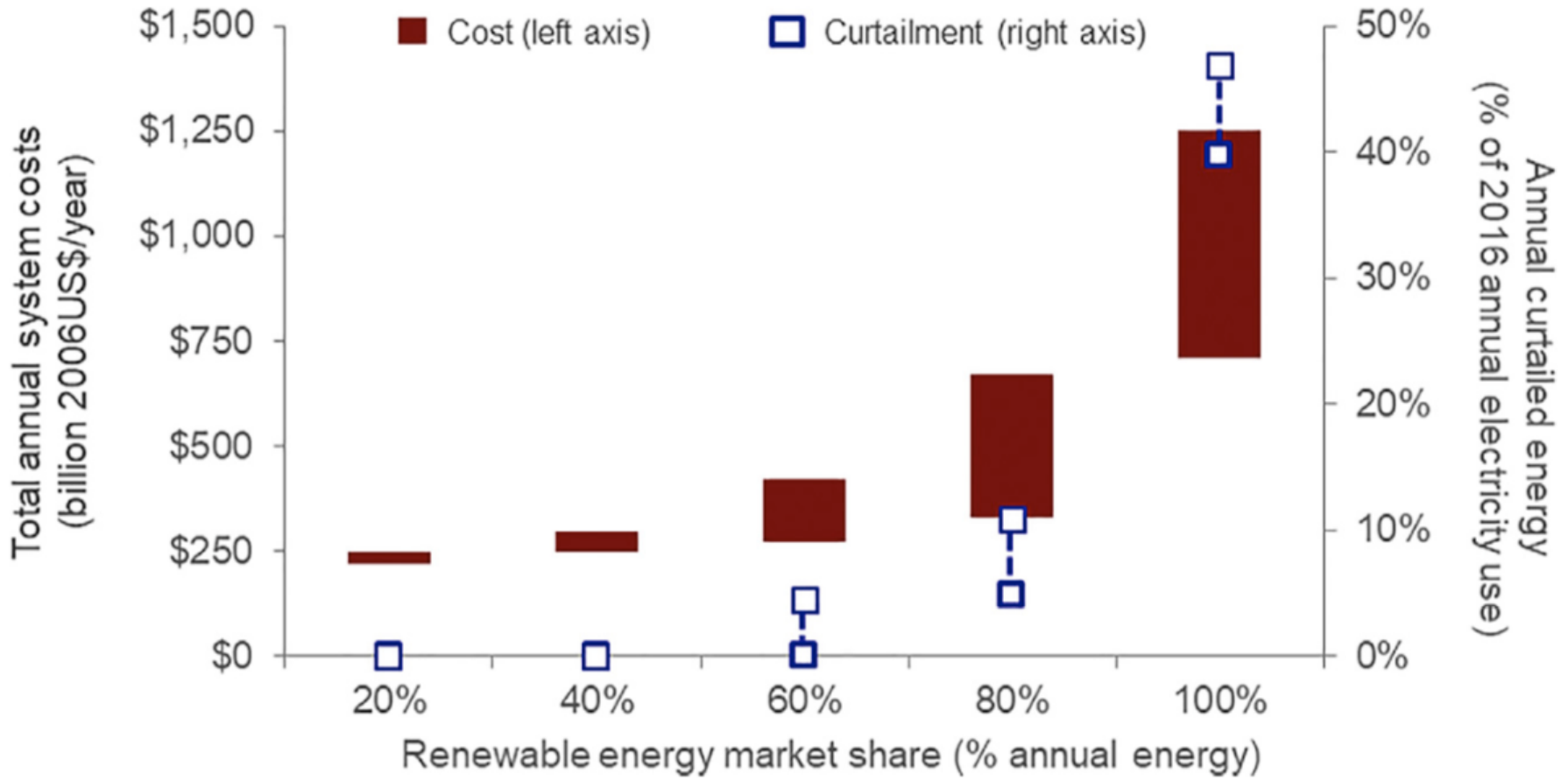
Utilization factor < 1%

Total cost of wind + solar+ storage = $1,612/MWH (vs current average generation cost of $50/MWH)

CAISO POWER SUPPLY COSTS
RPS LEVEL WITH FULL STORAGE



Same conclusions at national scale (copper plate trans-continental HVDC grid, demand response, storage)



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But ***all*** low carbon resources (firm and non-firm) have significant challenges

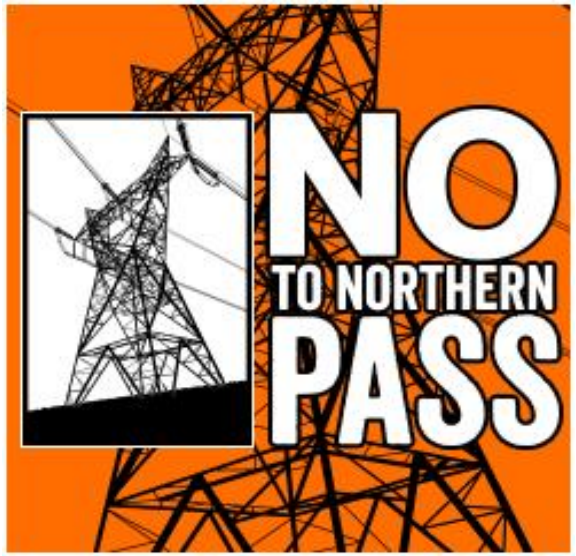
Nuclear – current cost challenges, public concern about waste and safety

Gas with carbon capture – still in early commercial stage, need to site pipeline and storage infrastructure, need to abate upstream emissions

Hydro – habitat, siting

Biomass – impact on land use and related carbon emissions, competition for cropping space

Solar and wind – cost challenges at high penetration described previously, large capacity times peak demand required, transmission siting

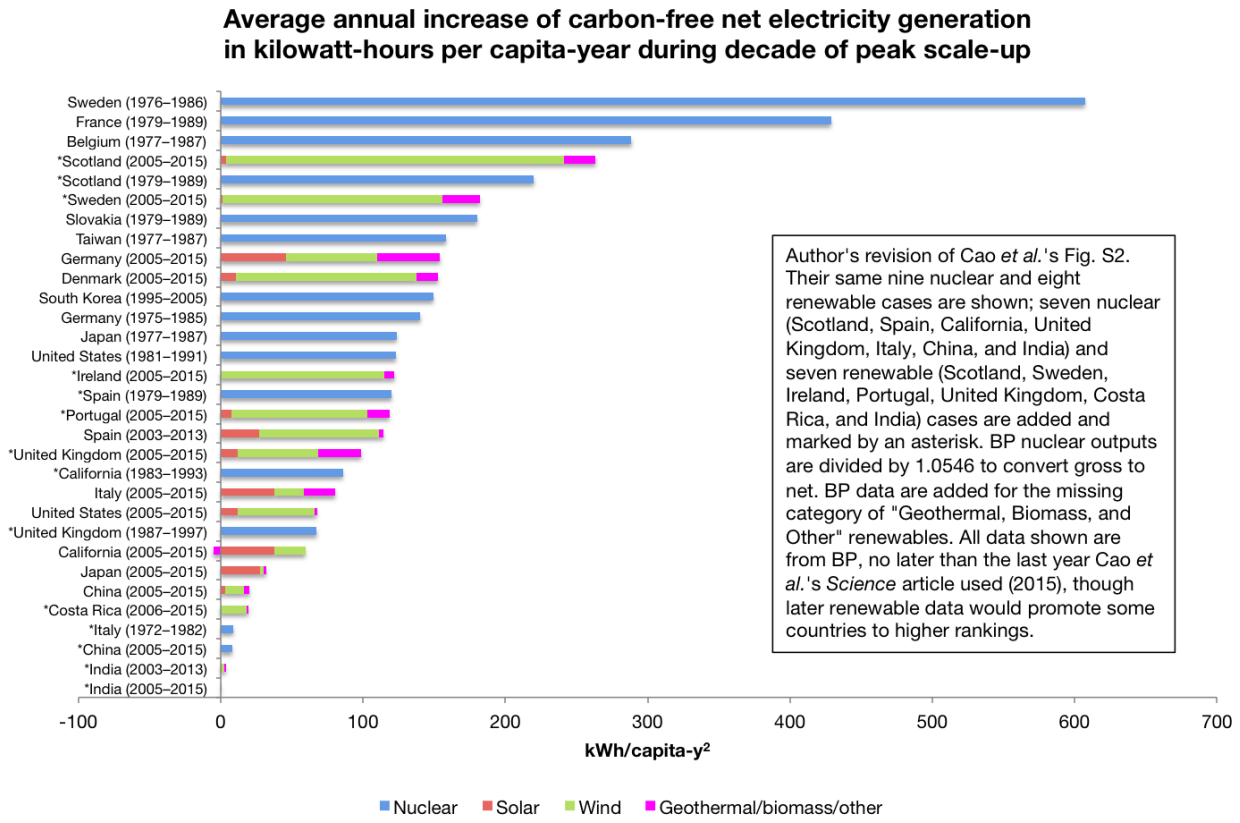

NO
TO NORTHERN
PASS


STOP
CPV - LAUREL RIDGE
INDUSTRIAL
WIND PROJECT
WTAJ
28°
5:35
STOCKER
POWERBALL
11 33 51 56 58 18
LOTTERY

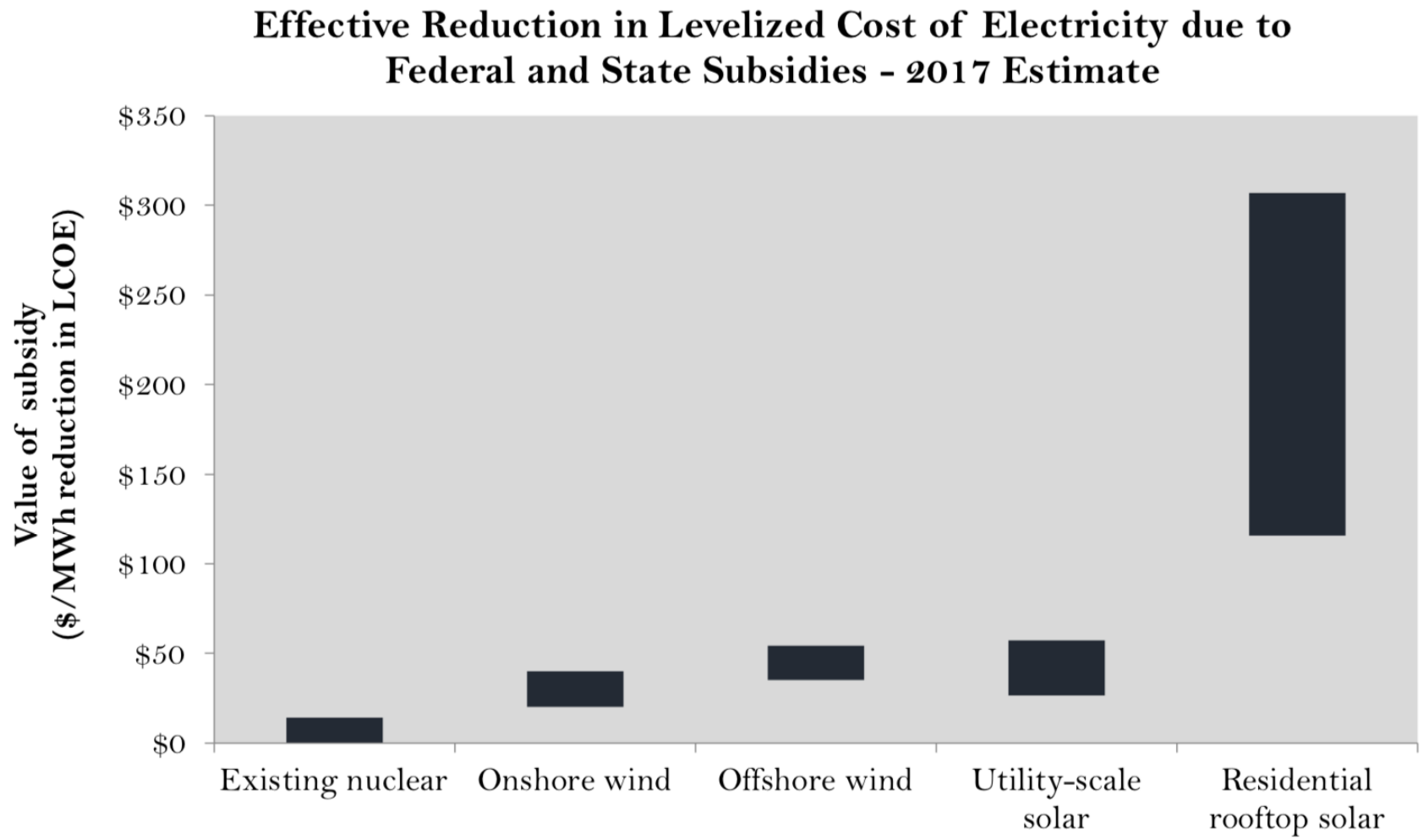
Advanced nuclear

Extra slides

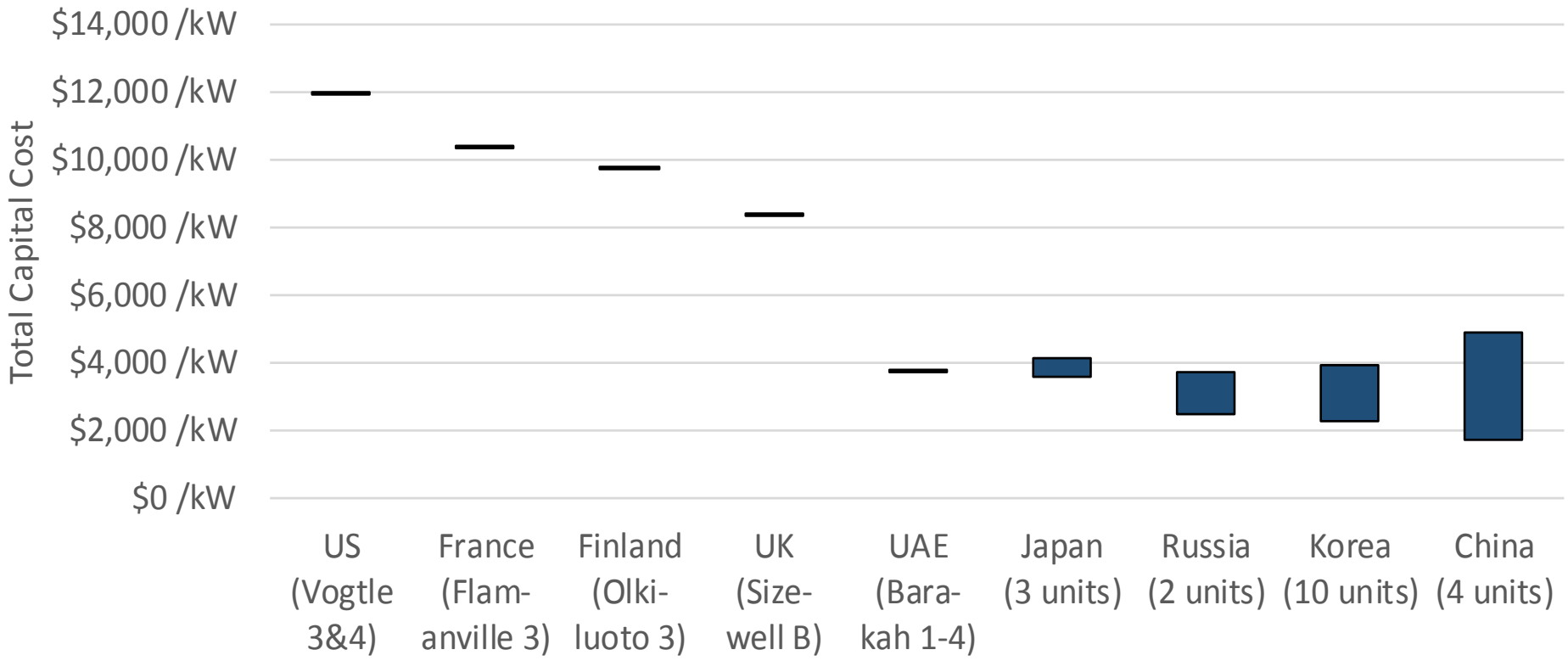
Nuclear can decarbonize a grid quickly



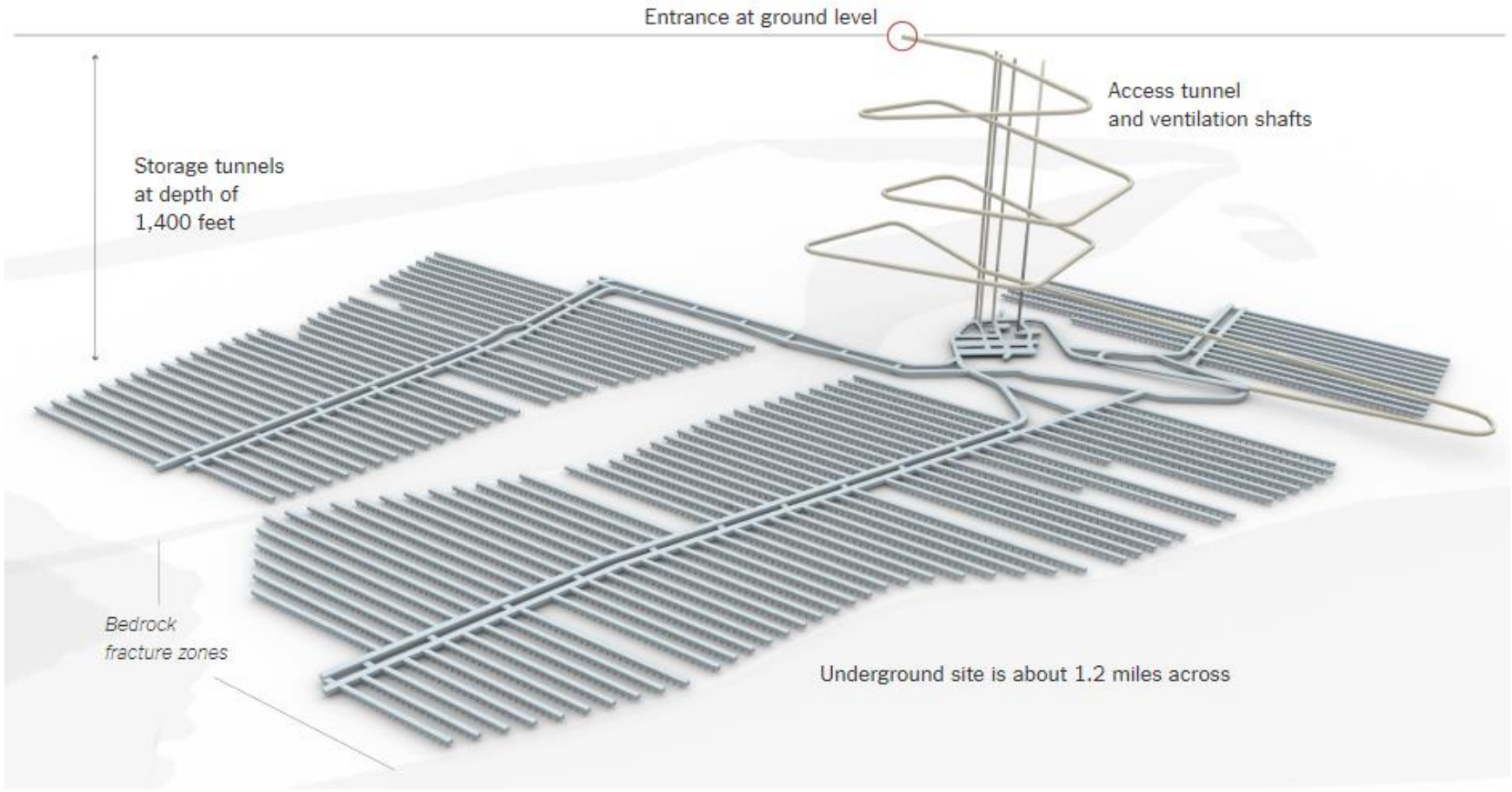
Operating subsidies compared



New nuclear cost: room for improvement!



Waste: not an unsolvable problem



Finland’s consent-sited waste repository under construction